DIFFERENCES BETWEEN MYCORRHIZAL AND NONMYCORRHIZAL ROOTS OF LOBLOLLY PINE

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A study was made of the physiological characteristics of mycorrhizal and nonmycorrhizal roots of loblolly pine seedlings (*Pinus taeda* L.) as an aid in evaluating their relative activity in mineral absorption. Roots were obtained from the forest and from potted seedlings growing both inside and outside of the greenhouse. No consistent differences were observed among roots from the various sources, but there was considerably more variation among pine roots than among barley roots, probably because pine roots vary more in age and rate of growth than barley roots grown for experimental purposes.

The material used in these experiments consisted entirely of vigorously growing root tips and contained no visibly suberized material. The roots were freed of foreign matter by brushing them under water with a camels hair brush. The length and average diameter of each root was measured and the surface area calculated by assuming the root to be a cylinder. After washing, the roots were blotted and their fresh weights recorded. They were dried at 103°C and reweighed to get their dry weights.

Mycorrhizal roots were found to contain over twice as much dry matter, expressed as percentage of fresh weight, as nonmycorrhizal roots. The average was 25,2 % for the former and 9,8 % for the latter in one experiment and 22,3 and 8,9 % in another series. Apparently the cells of mycorrhizal roots are arranged more compactly and contain more protoplasm and cell wall material per unit of volume than nonmycorrhizal roots. This means that results calculated on a dry weight basis may be somewhat different from those calculated on a fresh weight basis. Furthermore, because of their higher dry weight mycorrhizal roots have only about half as much surface area per unit of dry matter as nonmycorrhizal roots. The method of calculating surface area probably does not give a correct measure of the actual absorbing surface, however, because it does not include the surface area of the numerous fungal hyphae which cover the root and extend out into the soil. There seems to be no accurate way of estimating the actual absorbing surface of mycorrhizal roots in the soil, but the effective absorbing surface of mycorrhizal roots in soil must be much larger than it is in laboratory experiments.

Respiration measurements were made by the Warburg method on groups of both types of roots. Mycorrhizal roots absorbed about 1.4 times as much oxygen per unit of fresh weight as nonmycorrhizal roots, but absorbed considerably less oxygen per unit of dry weight and per unit of surface. Sodium azide (10^{-3}M) reduced oxygen uptake of both types of roots over 50 % and 2,4,-dinitrophenol (DNP, 10^{-5}M) increased oxygen uptake of nonmycorrhizal roots and of some lots of mycorrhizal roots, but the results were too variable to distinguish any consistent differences between the two types of roots.

Mineral absorption was studied by immersing groups of the two types of roots in phosphate buffer at pH 5.4 and adding the various isotopes to produce activities of 300 to 500 microcuries per liter. After immersion for several hours the roots were washed to remove radioactive material from the surface, weighed, and the activity of each root measured with conventional counting equipment. Mycorrhizal roots absorbed more P^{32} per unit of dry weight, per unit of fresh weight, and per unit of surface than nonmycorrhizal roots. Azide and DNP reduced uptake of P^{32} considerably less in mycorrhizal than in nonmycorrhizal roots. Replacement of oxygen by nitrogen also reduced uptake of P^{32} less in mycorrhizal than in nonmycorrhizal roots. In another series of experiments mycorrhizal roots absorbed more Sr^{90} and Ca^{45} per unit for dry weight and absorption of these isotopes was inhibited less by azide and DNP than in nonmycorrhizal roots. Mycorrhizal roots absorbed less Rb^{86} than nonmycorrhizal roots, but absorption was inhibited less by azide in the mycorrhizal roots.

The results of these experiments show that mycorrhizal roots differ from nonmycorrhizal roots in several ways and they apparently are able to absorb more of at least certain mineral elements per unit of surface than nonmycorrhizal roots.